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The Role of Quality Assurance in Collaborative Testing

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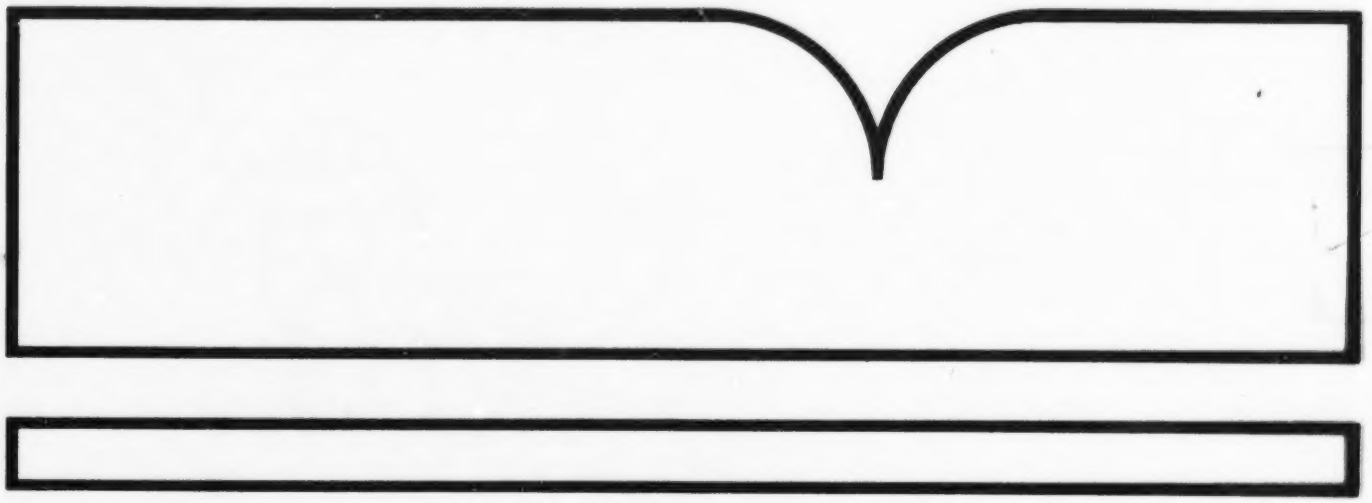

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The Role of Quality Assurance in Collaborative Testing

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Collaborative testing is the traditional means used to establish the precision of test methods. The role that quality assurance plays in the collaborative testing of U.S. Environmental Protection Agency stationary source test methods is presented. The applicability of the quality assurance procedures presented for routine use in compliance testing is also described.

Collaborative testing is the traditional means used to establish the within-laboratory and between-laboratory precision of test methods. For these precision estimates to be valid, the collaborative test design must ensure that all participants independently make the required number of measurements on identical samples using the same test method.

The objective of a quality assurance program in collaborative testing is to assure that the test results obtained are representative of those that should be obtained in normal use of the test method by any laboratory qualified to use the test method. Thus, the quality assurance program must ensure that all conditions for a valid collaborative test are met. That is: (1) the participants are qualified to use the test method; (2) all participants independently receive and analyze identical samples using the same test method; and (3) that a statistically significant number of samples are collected by each participant.

In a collaborative test of a stationary source test method, a real source must be used if the sampling as well as the analytical aspects of the test method are to be studied. This means that the collaborators must independently sample the same stack. But, since random changes in the pollutant profile and the velocity profile are common in most stacks, this means that all participants must simultaneously sample the stack to ensure that each has access to the same pollutant concentration.

These facts, coupled with the physical limitations of space that are characteristic of most stacks, require that special sampling conditions be employed when a stationary source test method is collaboratively tested.

This paper describes the quality assurance procedures that are employed in the collaborative testing of EPA stationary source test methods, the rationale for the specific procedures described, and the effects of these procedures on the test results. The purpose of this quality assurance program is to assure that the collaborative test results reflect the precision that should be obtained with the test method when a qualified laboratory uses it and that the precision estimates reflect the capabilities of the test method in general and not just at the specific source tested.

The quality assurance program described below is separate from the quality assurance program commonly included in the test method itself. Not all of the procedures described here apply to all collaborative tests of stationary source test methods. For example, in some instances the physical properties of the pollutant being measured permit straightforward sampling procedures to be used in the collaborative test. However, in some collaborative tests, such as those of EPA Methods 8 (sulfuric acid mist, sulfur dioxide) and 13 (fluoride), all of the following quality assurance procedures have been employed.[1,2]

Specific Quality Assurance Procedures

Assuring Participants Are Competent

It is imperative that the test participants be able to use the test method in a competent manner. Our early involvement in collaborative testing of stationary source test methods demonstrated that "experience" in using the method was not an adequate demonstration of competence. Therefore, as part of the selection process all potential collaborators are required to analyze standard samples and submit the results to the test coordinator along with resumes of the specific personnel who will participate, a list of the specific equipment they will use if they participate, and an estimate of the cost to the government for them to participate. The results from all laboratories are then used to eliminate from further consideration those laboratories which submitted results identified as statistical outliers ($>3\sigma$). The remaining laboratories are then further screened based on the resumes and list of equipment submitted. The laboratories that survive these checks are then ranked based on cost and the lowest bidders are selected.

The above criteria may seem too thorough, but experience supports the need for these requirements. For example, in the selection of collaborators for an evaluation of EPA Method 11 (hydrogen sulfide),[3] only 15 of 21 laboratories who analyzed the standards met our qualifications. In the selection of participants for a collaborative test of EPA Method 13 (fluorides),[2] only 9 out of 13 laboratories met our qualifications.

Assuring that Participants Selected Appear at the Test Site

In the real world, companies are paid for their efforts. Our experience has shown that collaborative test participants must also be paid under contract for their efforts to assure that: (1)

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they will be available on the dates required; and (2) they will be willing to work any additional hours or days required to complete a day's testing. For example, we have had volunteer laboratories rebel at working more than an eight hour day. This willingness to pay for services rendered, also dramatically increases the population of laboratories who are willing to participate in the collaborative test.

Assuring that Each Participant Uses the Same Test Method

Prior to subjecting a test method to a collaborative test the method is subjected to rigorous laboratory and field evaluations to assure that the procedures are clear and that the text of the method contains sufficient information concerning interferences, methods of calibration, equipment specifications, other necessary quality assurance procedures, etc. All collaborators are then supplied a copy of the test method and instructed not to substitute for any specific procedures described therein.

Assuring that Valid Estimates of Precision Are Obtained

A general rule in collaborative tests is "the more participants, the better the chance that the estimates of precision obtained will represent the overall capabilities of the method;" furthermore, the more times a laboratory analyzes the same sample, the better the estimate of within-laboratory precision. However, in source testing normal fluctuations in the pollutant concentration with time and space are common and thus sequential samples may not be true replicates. For this reason, whenever possible, we attempt to estimate the within-laboratory precision by having each collaborator operate two or more sampling trains simultaneously with their probe tips located very near each other in the stack.

In addition, most stacks have a maximum of four sampling ports, and space and sampling limitations prohibit installing additional ports. To achieve the desired number of test participants (6 to 8) it has been found advantageous to pair the laboratories such that two laboratories are simultaneously but independently sampling through the same port. These laboratory pairings are rotated between sampling runs on a random basis.

Employing the above sampling procedures allows the identification of statistical outliers that result from variations in the pollutant concentration from outliers that result from the test method itself. In this manner variations in the test results which are due to the source itself can be identified and compensated for before dealing with statistical outliers which result from use of the test method.

Other Quality Assurance Procedures Employed

In addition to the above, the following quality assurance procedures are a standard part of our collaborative testing program:

1) All collaborators are supplied standard samples for analysis along with their source samples.

2) Equipment to be used in the test is checked on-site prior to the test to be sure that it meets specifications described in the test method. For example, 40% of the meter boxes used in the collaborative tests of EPA Method 5 and Method 13 were determined to be incorrectly calibrated when checked at the test site.

3) Sufficient space is provided to assure that each participant has adequate room to assemble his equipment and recover his samples independently of the other laboratories.

4) It is not practical to have all participants visit the site prior to the test, so each collaborator is supplied detailed information about the plant, its operating schedule, physical dimensions, velocity profile, testing schedule, etc. prior to arriving at the test site.

5) Each collaborator is also given a list of sampling equipment which he is expected to supply for the test and a list of equipment which will be made available to him at the plant—e.g, trailer space, clean-up table, pulley, and similar items.

6) The testing is under the general direction of a test coordinator who assures that each laboratory operates independently of the others and that all laboratories initiate and terminate sampling at the same time. He also assures that each laboratory conducts all leak-checks, data recording, etc., described in the test method and that a statistically sufficient number of valid samples are taken.

The test coordinator is critical in assuring that the collaborative test results reflect the inherent precision of the method. He must ensure that all requirements for a valid collaborative test are met. At the same time, he must take care not to interfere with the performance of the test by the participants except when a specific procedure in the test method is either not being done or is being done in a manner prohibited in the test method. At times he may observe procedures being used which are different from the way he would do it, but are not in conflict with the specifications of the test method. In such cases he must not interfere despite all of his desires to do so, since the effect of his action could inject a bias toward greater precision in the collaborative test results. On the other hand inadequate intervention of the test coordinator can cause a precise test method to appear imprecise.

Summary

The objective of this quality assurance program is to assure that the collaborative test results are representative of those which would be obtained when any competent laboratory uses the test method. The important word here is competent. Obviously, if a laboratory is not competent to use the test method or does not follow the test method procedures, these estimates do not apply.

Besides assuring that valid data are obtained, employing the above quality assurance procedures has resulted in significant savings in the time required to conduct the collaborative test and thus has yielded considerable reductions in the cost of the testing program. Unfortunately, these procedures do not now seem to be routinely used in source testing for compliance purposes. If they were, it seems reasonable to expect an improvement in the quality of the data and a reduction in the cost of the test.

References

1. W. J. Mitchell and M. R. Midgett. "Precision Estimates for EPA Test Method 8—SO_2 and H_2SO_4 Emissions from Sulfuric Acid Plants," *Atmos. Environ.* **13:** 179 (1979).
2. W. J. Mitchell and M. R. Midgett. "Collaborative Study of EPA Method 13A and Method 13B," USEPA Publication EPA-600/4-77-050, Research Triangle Park, NC, December 1977.
3. G. W. Scheil, M. C. Sharp. "Standardization of Method 11 at a Petroleum Refinery," USEPA Publication EPA-600/4-77-008b, Research Triangle Park, NC, January 1977.

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